

## Claims

1. A pattern defect inspection apparatus comprising:  
a recipe setting unit for setting an inspection  
recipe and/or a review recipe;

an illumination optical system including:

a laser light source for emitting ultraviolet  
laser light;

a quantity-of-light adjusting unit for adjusting  
a quantity of the ultraviolet laser light emitted from the  
laser light source in accordance with the inspection recipe  
and/or the review recipe set by the recipe setting unit;

an illumination range forming unit for forming on  
a sample an illumination range of the ultraviolet laser  
light whose quantity has been adjusted by the quantity-of-  
light adjusting unit;

a coherence reducing system for reducing  
coherence of the ultraviolet laser light received within  
the illumination range that has been formed by the  
illumination range forming unit; and

an irradiation optical system for irradiating the  
sample with a ultraviolet light flux whose coherence has  
been reduced by the coherence reducing system; and

a detection optical system including:

a condensing optical system for condensing light

reflected from the sample;

a diffracted-light control optical system for controlling diffracted light of the reflected light that has been condensed by the condensing optical system; and

a detecting unit for imaging a reflected light image coming from the sample to detect an image signal, said reflected light image being obtained through the diffracted-light control optical system.

2. A pattern defect inspection apparatus comprising:

a recipe setting unit for setting an inspection recipe and/or a review recipe;

a quantity-of-light calculating unit for calculating a quantity of ultraviolet laser light in accordance with the inspection recipe and/or the review recipe that have been set by the recipe setting unit;

an illumination optical system including:

a laser light source for emitting ultraviolet laser light;

a quantity-of-light adjusting unit for adjusting the quantity of the ultraviolet laser light, which has been emitted from the laser light source, to the quantity of light calculated by the quantity-of-light calculating unit;

an illumination range forming unit for forming in a sample an illumination range of the ultraviolet laser light whose quantity has been adjusted by the quantity-of-

light adjusting unit;

a coherence reducing system for reducing coherence of the ultraviolet laser light received within the illumination range that has been formed by the illumination range forming unit; and

an irradiation optical system for irradiating the sample with a ultraviolet light flux whose coherence has been reduced by the coherence reducing system; and

a detection optical system including:

a condensing optical system for condensing light reflected from the sample;

a diffracted-light control optical system for controlling diffracted light of the reflected light that has been condensed by the condensing optical system; and

a detecting unit for imaging a reflected light image coming from the sample to detect an image signal, said reflected light image being obtained through the diffracted-light control optical system.

3. A pattern defect inspection apparatus according to claim 1, further comprising:

an image processing unit for detecting a defect of a pattern formed on the sample on the basis of the detection image signal detected by a detector provided in the detecting unit.

4. A pattern defect inspection apparatus according

to claim 1, wherein said recipe setting unit has a recipe setting screen.

5. A pattern defect inspection apparatus according to claim 1, wherein said quantity-of-light adjusting unit has an optical element capable of controlling the ultraviolet laser light emitted from the laser light source so that the ultraviolet laser light is switched between a state close to ON and a state close to OFF.

6. A pattern defect inspection apparatus according to claim 1, wherein:

said quantity-of-light adjusting unit has an optical element capable of controlling the ultraviolet laser light emitted from the laser light source so that the ultraviolet laser light is switched between a state close to ON and a state close to OFF; and

said optical element can arbitrarily control a period of time during which the ultraviolet laser light is in a state close to OFF.

7. A pattern defect inspection apparatus according to claim 1, wherein said quantity-of-light adjusting unit has a filter capable of changing the quantity of transmitted light.

8. A pattern defect inspection apparatus according to claim 7, wherein said filter is devised not to return light reflected from an incident plane to the laser light

source.

9. A pattern defect inspection apparatus according to claim 1, wherein:

said detecting unit of the detection optical system comprises a first detector for detecting an image signal for inspection and a second detector for detecting an image signal for viewing, each of said first detector and said second detector being imaged a reflected light image obtained from the sample through the diffracted-light control system by switching a switching optical system between at the time of the inspection and the viewing.

10. A pattern defect inspection apparatus according to claim 1, wherein said first detector comprises an accumulated type image sensor.

11. A pattern defect inspection apparatus according to claim 3, wherein said image processing unit comprises:

a storage unit for storing a digital reference image signal;

a brightness correcting unit for correcting brightness of at least one of the digital image signals so that brightness in a normal portion of the digital detection image signal, which has been detected by the first detector and then converted into the digital signal, becomes substantially the same as brightness of a normal portion of the digital reference image signal stored in the

storage unit; and

a defect detecting unit for detecting a defect of a pattern formed on the sample by comparing the digital detection image signal corrected by the brightness correcting unit with the digital reference image signal.

12. A pattern defect inspection apparatus according to claim 3, wherein said image processing unit comprises:

a storage unit for storing a digital reference image signal;

a scatter-diagram creation unit for creating a scatter diagram illustrating an association between a feature index in a normal portion of the digital detection image signal and a feature index in a normal portion of the digital reference image signal stored in the storage unit, said digital detection image signal being detected by the first detector and then being converted into a digital signal;

a local gray-scale converter for correcting a local gray scale value of at least one of the digital image signals on the basis of the scatter diagram created by the scatter-diagram creation unit; and

a defect detecting unit for detecting a defect of a pattern formed on the sample by comparing the digital detection image signal corrected by the local gray-scale converter with the digital reference image signal.

13. A pattern defect inspection apparatus according to claim 1, wherein said diffracted-light control optical system comprises a polarization element group.

14. A pattern defect inspection apparatus comprising:

a laser light source for emitting laser light;

an illumination optical system for reducing coherence of the laser light emitted from the laser light source before irradiating a sample with the laser light;

a detection optical system for detecting an image of the sample irradiated by the illumination optical system; and

an image processing unit for handling the image of the sample detected by the detection optical system;

wherein said inspection apparatus handles a wafer having a diameter of 300 mm at a speed equivalent to a throughput of three pieces of wafers or more per hour, and detects a defect having a size of 100 nm included in a pattern formed on the sample.

15. A pattern defect inspection method comprising:

a recipe setting step for setting an inspection recipe and/or a review recipe;

an illumination step comprising the sub-steps of:

adjusting by quantity-of-light adjusting unit a quantity of ultraviolet laser light emitted from a laser

light source in accordance with the inspection recipe and/or the review recipe set by the recipe setting step;

forming by illumination range forming unit an illumination range of the adjusted ultraviolet laser light in a sample;

reducing by coherence reducing system coherence of the ultraviolet laser light received within the formed illumination range; and

irradiating by an irradiation optical system the sample with the ultraviolet light flux whose coherence has been reduced; and

a detection step comprising the sub-steps of:

condensing reflected light coming from the sample by a condensing optical system;

controlling diffracted light of the condensed reflected light by a diffracted-light control optical system; and

imaging by a detector a reflected light image from the sample to detect an image signal, said reflected light image being obtained by the control.

16. A pattern defect inspection method comprising:

a recipe setting step for setting an inspection recipe and/or a review recipe;

a quantity-of-light calculating step for calculating a quantity of ultraviolet laser light in accordance with

the inspection recipe and/or the review recipe that have been set by the recipe setting step;

an illumination step comprising the sub-steps of:

adjusting by a quantity-of-light adjusting unit the quantity of ultraviolet laser light emitted from a laser light source so as to become the quantity of light calculated by the quantity-of-light calculating step;

forming by illumination range forming unit an illumination range of the adjusted ultraviolet laser light in a sample;

reducing by coherence reducing system coherence of the ultraviolet laser light received within the formed illumination range; and

irradiating by an irradiation optical system the sample with the ultraviolet light flux whose coherence has been reduced; and

a detection step comprising the sub-steps of:

condensing reflected light coming from the sample by a condensing optical system;

controlling diffracted light of the condensed reflected light by a diffracted-light control optical system; and

imaging by a detector a reflected light image from the sample to detect an image signal, said reflected light image being obtained by the control.

17. A pattern defect inspection method according to claim 15, further comprising:

an image processing step for detecting a defect of a pattern formed on the sample on the basis of the detection image signal detected by the detector in an image processing unit.

18. A pattern defect inspection method according to claim 15, wherein, in the recipe setting step, the inspection recipe and/or the review recipe are set on a recipe setting screen.

19. A pattern defect inspection method according to claim 15, wherein the quantity of light is adjusted by use of an optical element capable of controlling the quantity of light so that the quantity of light is switched between a state close to ON and a state close to OFF.

20. A pattern defect inspection method comprising:

an illumination step for irradiating a sample with ultraviolet light flux; and

a step for obtaining an image signal by imaging the irradiated sample,  
wherein:

said illumination step further comprises the sub-steps of:

adjusting the quantity of ultraviolet laser light emitted from a laser light source by quantity-of-light

adjusting unit in accordance with a state of a sample;

forming by illumination range forming unit an illumination range of the adjusted ultraviolet laser light in a sample;

reducing by coherence reducing system coherence of the ultraviolet laser light received within the formed illumination range; and

irradiating by an irradiation optical system the sample with the ultraviolet light flux whose coherence has been reduced; and

said step for obtaining an image signal further comprises the sub-steps of:

condensing reflected light coming from the sample by a condensing optical system;

controlling diffracted light of the condensed reflected light by a diffracted-light control optical system; and

imaging by a detector a reflected light image from the sample to detect an image signal, said reflected light image being obtained by the control.

21. A pattern defect inspection method comprising:

irradiating a wafer having a diameter of 300 mm with ultraviolet laser light whose coherence has been reduced;

imaging the irradiated wafer to detect an image of the wafer; and

handling the detected image of the wafer to detect a defect having a size of 100 nm or less in a pattern formed on the wafer with a throughput of three pieces of wafers or more per hour.